Democracy Dies in Darkness

Scientists have said that we can cool the planet back down. Now they're not sure it will be so easy.

It might be possible to "overshoot" and then return to our climate targets. But some changes will be irreversible.

October 9, 2024

By Shannon Osaka

For years, scientists and world leaders have pinned their hopes for the future on a hazy promise — that, even if temperatures soar far above global targets, the planet can eventually be cooled back down.

This phenomenon, known as a temperature "overshoot," has been baked into most climate models and plans for the future. In theory, even if global warming reaches the dreaded 1.5 degrees Celsius (2.7 degrees Fahrenheit) above preindustrial temperatures, it could be brought back down by pulling carbon dioxide out of the atmosphere.

But a new study published Wednesday in the journal Nature shows that blowing past climate goals is more dangerous than it originally seemed. Even if temperatures come back down to 1.5 degrees C, the authors found, many climate impacts — like rising sea levels and thawing permafrost — will persist for centuries to millennia.

For example, for every 10 years Earth's temperature remains 1.5 degrees C above preindustrial levels, the researchers calculated, sea level will rise by about 4 centimeters, or 1.6 inches. Even a small increase in sea-level rise can lead to more dangerous flooding when hurricanes and heavy rains strike. (In Florida, which is currently facing the danger of Hurricane Milton, sea levels are already 8 inches higher than they were in 1950.)

And as the planet teeters closer to that temperature limit, overshoot is looking more and more likely.

"A 1-in-10 chance of an existential threat is not small," Joeri Rogelj, a professor of climate science at Imperial College London and one of the authors of the new paper, said on a phone call with reporters on Tuesday.

Since the Paris agreement, world leaders have promised to attempt to hold the global temperature rise to 1.5 degrees C. That target has stayed in place, even as countries have failed to limit fossil fuel burning: Carbon dioxide concentrations in the atmosphere are rising at a record pace, according to observations in March at Hawaii's Mauna Loa Observatory.

But in a special United Nations report in 2018, scientists and climate modelers popularized a controversial idea: that nations could "overshoot" the target temporarily, and then bring temperatures back down in the future.

By using techniques like direct air capture or other forms of sucking carbon out of the atmosphere, scientists said, countries could cool the Earth back down even if the planet has already reached 1.6 C or 1.7 C above preindustrial levels.

In recent years, as emissions have continued to climb, the idea of "overshooting" climate targets hasn't just become popular — it's now essential to reach the world's most famous climate goal.

"Emissions reductions haven't happened as planned," said Glen Peters, a senior researcher at the Center for International Climate Research in Norway who was not involved in the new study. "So if you still want to get to 1.5 degrees, you need overshoot."

Last year, The Washington Post analyzed 1,200 pathways to 1.5 degrees C, and found that there were no pathways with "reasonable" assumptions about technological development that didn't include some kind of overshoot.

But scientists have begun to warn that flying past our climate goals and then returning to them isn't the same as meeting them in the first place.

In the new study, the authors warn that sea-level rise and melting permafrost may be irreversible for hundreds, if not thousands of years, even if temperatures later come back down. The extinction of species that could result from these massive planetary shifts, they added, are also not reversible.

"Excess deaths are not reversible," said Rogelj. "If you have a couple of decades in which large proportions of vulnerable people are exposed to extreme heat in a society that is not adapted to this — that's not reversible."

Other recent papers have shown that catastrophic tipping points are more likely for each increment above 1.5 degrees C. In a study released in Nature Communications in August, researchers found that every tenth of a degree above that threshold increased the likelihood of triggering tipping points — like the Amazon rainforest transforming into a dry savanna or the collapse of the Atlantic Ocean circulation system — by 1 to 1.5 percent.

At the same time, scientists warn that cooling the planet might not even be technically feasible. The tools to pull carbon dioxide out of the atmosphere and reverse warming have not been deployed at a large scale. At the moment, companies pull about 2 million tons of CO_2 out of the air every year — but that number would need to be increased by a factor of 1,000 in just the next few decades.

And future generations may not even be motivated to do so. Oliver Geden, a senior fellow at the German Institute for International and Security Affairs, says that once the world warms more than 1.5 degrees C, countries may not want to spend the money and energy to bring temperatures back down. “We’re in a world that does not even manage to bring emissions down now,” he said.

One thing, scientists say, is clear: Humanity is headed for a world with more than 1.5 degrees C of warming. The planet has already experienced a 12-month period during which temperatures exceeded that limit, and by the early 2030s, it will be above that mark for multiple years at a time — which is what matters under the text of the Paris agreement.

Overshoot is a way of softening that blow, of making it seem like the world’s climate target is still within reach. But sooner or later, world leaders will have to wrestle with the fact that the most famous climate goal is impossible to meet.

Geden says that many scientists accept that the world will go beyond 1.5 degrees C. “But,” he added, “nobody can decide what the next target will be.”